REMARKS/ARGUMENTS

By this Amendment, claims 1, 6 and 15 are amended. Claims 1-2, 5-7, 9 and 15 are pending.

Favorable reconsideration is respectfully requested in view of the foregoing amendments and the following remarks.

REJECTION UNDER 35 U.S.C. § 103:

The Examiner rejected claims 1, 2 and 15 under 35 U.S.C. § 103(a) as being unpatentable over U.S. Patent No. 6,057,022 (Purdy et al.) in view of U.S. Patent No. 3,897,582 (Olcott) or EP 1260729 (Johnson). The Examiner also rejected claims 1, 2, 5-7, 9 and 15 under 35 U.S.C. § 103(a) as being unpatentable over U.S. Patent No. 6,042,935 (Krenkel) or U.S. Publication No. 2003/0057040 (Bauer) or U.S. Patent No. 6,221,475 (Domergue) or U.S. Publication No. 2002/0068164 Al (Martin) in view of GB 2298687 (Fennell) to Purdy et al. or U.S. Patent No. 6,079,525 (Dietrich et al.) and further in view of Olcott and Johnson. These rejections are traversed for the reasons that follow.

Independent Claims 1, 6 and 15 have each been amended to clarify that the core layer and wear layer are each annular and that the wear layer is attached to the major face of the core layer. These amendments are supported throughout the specification as filed, including by the drawings.

Lines 8 and 9 of page 5 of the present specification provide that:

> "Figure 2 is an illustration of a cross section through a **disc** of the invention showing the C-C wear faces (23) bonded to a core (22)"

(emphasis and reference numerals added).

A person skilled in the art understands that since the complete assembly (11) shown in Figure 2 is a disc, then each of the core (22) and the wear faces (23) are annular. Moreover, a person skilled in the art understands that the wear layers are joined to the flat major faces of the annular core, not least because there are no curved surfaces shown in the plane of the cross section shown in Figure 2. Moreover, line 16 to 17 of page 5 describes wear surfaces as attached to the major faces of the disc.

That each of the discs in an aircraft brake heat stack is annular is, of course, known to a person skilled in the art because the torque tube passes through the central aperture in each to form the stack.

It should be noted that the terms "wear" and "core" as applied to parts of a brake disc are familiar to the person skilled in the art, as is the positioning of wear section on core section. By way of demonstration, the Applicant refers the Examiner to U.S. Patent No. 3,712,427 (Cook) which is cited in the application in suit. Cook describes, for example, wear plates 22 [attached to] each face of the core 20 (see line 64 to 65 of column 1). For the avoidance of doubt, however, the Applicant points out that the wear plates and core plate of Cook are made from the same graphite or carbon base material and thus do not have differing densities.

The Examiner has reissued her rejection of Claims 1, 2 and 15 under 35 U.S.C. §103(a), arguing that those claims are not inventive based on Purdy in view of Olcott and Johnson. The

Examiner has also reissued her rejection of Claims 1, 2, 5 to 7, 9 and 15 under 35 U.S.C §103(a), arguing that those claims are not inventive over Krenkel or Bauer or Domergue or Martin in view of GB 2298687 (Fennell) or Dietrich and further in view of Olcott and Johnson. The Applicant is disappointed that this application appears to have reached this impasse, particularly in view of the Applicant's productive meeting with Examiner Bradley T. King.

The Applicant has proposed the present amendments to further distinguish his invention from the art cited by the Examiner and in an attempt to further accelerate its allowance. The amendments offered are without prejudice and in no way should be construed as an acceptance of the Examiner's position vis-à-vis the patentability of the previously presented claims, which is denied.

Purdy, as has been extensively discussed, describes a method for the chemical vapour infiltration (CVI) of porous carbon structures, only some of such so-formed bodies may be used for aircraft brakes. As the Examiner notes, Purdy does not disclose the use of refractory carbides.

However, contrary to the Examiner's opinion and as the Applicant has previously and extensively argued, Purdy **does not** describe an annular core layer having an annular wear layer attached to a major face thereof, where the core layer is more dense than the wear layer.

Lines 28 to 30 of column 3 of Purdy provide that an object of the disclosure is to provide a method for rapidly and **uniformly** densifying porous structures. Moreover, Purdy describes unitary structures, rather than composites of two or more parts. Even where Purdy shows a disc where the region of the major face of the disc is predominantly of a different density to the core,

such as in figures 9 and 13, the density at the major face is **greater** than in the core. Meanwhile, the disc shown in Figure 8 is expressly described as being unsuitable for use as a brake disc (see line 39 to 40 of column 2 of Purdy).

The present invention on the other hand requires a composite of an annular wear layer attached to the major face of an annular core layer, where the core layer is impregnated with refractory carbide and is denser than the wear layer.

In order for the Examiner's objection to stand, she therefore needs to show that Johnson or Olcott positively teach all of:

(i) a **non-unitary** composite brake disc having a wear layer joined to the major face of a core layer;

(ii) a **core layer** impregnated with refractory carbide;

(iii) a non-uniform density profile between the wear and core layers is desirable; and

(iv) that the density profile should be such that the core layer is more dense than the wear layer.

The Examiner, to the frustration of the Applicant, does not explain where she finds the remedies for these deficiencies of Purdy in Olcott or Johnson.

The Examiner refers the Applicant to the abstract of Johnson, which describes a laminate of carbon fibre material which is used with silicon particles to create a disc with a central wear resistance region and a peripheral machinable region.

In itself, the abstract of Johnson appears to offer little, except that refractory carbides might be useful in braking elements. In fact, paragraph [0009] of Johnson provides that the

friction properties of refractory carbides are desirable, yet claim 1 of the application in suit requires their use in the core layer and not the wear or friction layer. No mention is made of any density gradient across the finished brake disc. Indeed, it is positively taught against in Johnson where each and every layer has silicon deposited thereon to be converted to SiC. Any layer without silicon is machined away to form a suitable disc.

Olcott also notes that refractory carbides have improved frictional resistance properties (lines 63 to 64 of column 2), which points to their use as a wear layer rather than specifically in a core layer and **not** in a wear layer.

The density of different regions of a brake disc is not discussed in Olcott.

Neither of Olcott or Johnson, therefore, could be combined with Purdy to reach the invention of Claims 1, 6 or 15 because even in combination there is no disc described having an annular core layer comprising a refractory carbide and having a less dense wear layer attached to a major face portion thereof.

The Examiner has repeatedly ignored the density requirements of the independent claims in her rejections. The Applicant however points out that this feature is key to both the function of the invention and the difference between the invention and the prior art. Where the prior art typically requires a dense friction face, the applicant has in fact made the core denser. In doing so, he has reduced the size of the disc at no performance cost. In reducing heat pack size, the other brake components may be reduced in size, thereby being able to provide real weight savings in the finished brake.

The Examiner has also maintained her rejection of all pending Claims under 35 U.S.C § 103(a) over Krenkel, Bauer, Domergue or Martin in view of Purdy or Dietrich and further in view of Olcott and Johnson. Again, the Applicant must express his disappointment that the Examiner has reverted to this rejection, which is in stark contrast to the opinion of Examiner King.

Krenkel describes a brake disc having a core body and two friction bodies attached thereto, where both core and friction bodies are infiltrated with silicon (column 5, lines 59-61). Moreover, the friction bodies are required to have an "extremely dense material surface" (column 7, line 14), thereby teaching away from a core which is more dense than the friction layer.

Bauer describes a multi-layer brake disc which has a friction layer having a SiC content of greater than 65% (paragraph [0011]). It is also provided that the compositions of the C/SiC are adjusted in the brake disc in such a way that the SiC content of the support zone is less than that in the friction layer (paragraph [0016]). The skilled person understands that this means that the density in the friction layer is **higher** than in the support or core layer. This is, as noted previously, in direct contrast to the requirements of claims 1, 6 and 15.

Martin describes a brake disc having a core body and a friction body made up of a similar silicon carbide material (paragraph [0021]). This means that the density of the core and friction body will also be the same. The density of the core body is therefore **not** described as being greater than the friction body.

Domergue describes a brake disc which has a friction face and a core where the core of the disc is made at least in part from a composite material in which the matrix does not have a silicon carbon phase (see lines 1 to 3 of column 2).

The friction face, however, has a silicon carbide phase which apparently improves braking efficiency (see lines 52 to 65 of column 3).

The skilled person understands that this teaching requires that the core region has a lower density than the friction region, in contrast to the requirements of claims 1, 6 and 15. Moreover, the thrust of the teaching is such that an absence of SiC at the core is preferred, which once again represents a polar opposite teaching to the presently claimed invention.

The picture that this prior art paints is that the density of the friction layer of a brake disc should be at least as great as the density of its core and should preferably be greater.

Moreover, if the skilled person were to choose where to concentrate any SiC in a disc on the basis of these documents, he would unquestionably place it in the friction regions, on account of its disclosed excellent frictional properties.

A valid obviousness type rejection would, therefore, require at least one of the remaining references to explicitly reverse this teaching to cite that a core layer should be more dense than the wear layer.

It is not enough to state that a person skilled in the art would optimize the relevant densities of the core and wear layers because the presently claimed invention requires a radical rethinking of the configuration of the disc and the accepted standpoint of the person skilled in the art. While a person skilled in the art may have been able to find an optimum ratio of the density

of wear layer to core layer if the wear layer were to be the denser, he or she is provided with no incentive or guidance to invert that ratio.

Dietrich describes a brake disc which interacts with a brake lining during a braking procedure. Although the disc and lining are of different densities, they do not represent an annular core layer and an annular wear layer attached to a major face thereof. In fact, they are not even attached and would not work if they were. Dietrich therefore, does not reverse a person skilled in the art's understanding of the density configuration of a brake disc.

GB 2298687 (Fennell) describes a brake disc which has a drive region and a friction region. There appears to be no reference to the use of SiC and it is noted that the composite density is less in the drive regions than in the friction regions. Although GB 2298687 (Fennell) does not describe an annular core layer and an annular wear layer attached to a major face thereof, as within the definitions of Claims 1, 6 and 15, it therefore appears to reinforce a person skilled in the art's view that a friction region should be the denser part of a brake disc.

GB 2298687 (Fennell), therefore, teaches away from the presently claimed invention, rather than bringing a person skilled in the art closer to it.

As is noted above, the references of Olcott and Johnson do not describe brake discs where a core layer is more dense than the wear layer.

It is therefore submitted that independent claims 1, 6 and 15 are inventive over Krenkel, Bauer, Domergue or Martin in view of Olcott or Johnson.

Moreover, it is submitted that dependent Claims 2, 5, 7 and 9 are thus inventive over the prior art of record and that the application is in a condition for allowance.

The Applicant therefore submits that all of the Examiner's rejections have been overcome and that the application has been placed in a condition for allowance.

For at least the reasons set forth above, it is respectfully submitted that the above-identified application is in condition for allowance. Favorable reconsideration and prompt allowance of the claims are respectfully requested.

Should the Examiner believe that anything further is desirable in order to place the application in even better condition for allowance, the Examiner is invited to contact Applicant's undersigned attorney at the telephone number listed below.

Respectfully submitted,

CAESAR, RIVISE, BERNSTEIN,
COHEN & POKOTILOW, LTD.

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By: 

Gary A. Greene
Registration No. 38,897
Customer No. 03000
(215) 567-2010
Attorneys for Applicant

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